Systemic Preoperative Antibiotics with Mandible Fractures: Are They Indicated at the Time of Injury?

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Abstract

Mandible fractures are the most common result of facial trauma. The proximity of oral flora to the site of both the injury and resulting surgical instrumentation makes managing infection a unique challenge. The benefit of antibiotic prophylaxis at the time of surgical treatment of mandible fractures is well established. However, the routine use of antibiotics between the time of injury and surgery is of unclear benefit. We aim to define the role of antibiotics in the preoperative period: from the time of injury to surgical intervention. Demographic and clinical data were collected retrospectively on all patients who were treated for mandible fracture by the Division of Plastic and Reconstructive Surgery at our institution between 2003 and 2013. The use of both preoperative (between injury and surgery) and perioperative (at the time of surgery) systemic antibiotics was recorded along with the incidence of postoperative infections and other complications. Complete data were available for 269 patients. Of the 216 patients who received preoperative antibiotics, 22 (10%) developed an infection postoperatively. Of the 53 patients who did not receive preoperative antibiotics, 2 (4%) developed infection ($p = 0.184$). Likewise, preoperative antibiotics were not significantly associated with hardware complication rates. In our retrospective review, the use of antibiotics between injury and surgical repair had no impact on postoperative infection rates. These data suggest that preoperative antibiotic use may actually be associated with an increased incidence of postoperative infection. Our results do not support the routine use of antibiotics between injury and surgical repair in patients with mandible fractures.

Keywords
- mandible fractures
- preoperative antibiotics
- facial trauma

Mandible fractures, the most common result of facial trauma in both adults and children,[1–3] are most often diagnosed in the emergency department. Their detection has been improved by routine use of computed tomography (CT), which is considered the gold standard for the diagnosis of bony injuries in facial trauma.[4,5] These fractures are most often scheduled for operative repair on an outpatient basis, and from the time of injury to surgical intervention, patients are often prescribed oral antibiotic therapy. A 2015 survey[6] indicated that 69% of prescribers routinely use preoperative antibiotics for an average of 4.7 days prior to fixation of mandible fractures. However, high-quality evidence for the

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routine use of antibiotics in the preoperative period is lacking and often incongruent with prescriber's practice.[6]

Importance

There have been remarkably few studies specifically evaluating the use of antibiotics in the period between injury and surgical repair. One retrospective analysis showed that pre- or postoperative antibiotics did not decrease infection rates when added to a standard perioperative antibiotic regimen in complex facial fractures, but isolated mandible fractures were excluded from this analysis.[7] Furr et al concluded that use of antibiotics in patients with mandible fractures at the time of injury or after repair was unrelated to the development of postoperative infection.[8] Recently, Gaal and colleagues reported that limiting antibiotics to the perioperative period in patients with mandible fractures did not significantly change the rate of surgical site infections.[9] There is literature that does support the use of preoperative antibiotics for comminuted mandible fractures,[6,10,11] but these reports group together preoperative and perioperative antibiotics in their analysis.[12–14]

Goals of This Investigation

The aim of this article is to evaluate use of oral antibiotics between the time of injury and surgical repair of mandible fractures and to analyze their effect on postoperative infection.

Methods

Study Design and Participant Selection

We performed a retrospective observational study of patients with mandible fractures. After approval from the Institutional Review Board, all patients who had undergone operative repair of a mandible fracture between 2003 and 2013 by the Division of Plastic and Reconstructive Surgery were collected via a billing database search.

Data Collection

For each patient, basic demographic data, mechanism of injury, time from injury to surgery, fracture location, procedure performed, use of hardware for fixation, and smoking status were collected. In addition, use of antibiotics around the time of surgery was recorded, including preoperative antibiotic choice and duration. For this study, preoperative antibiotics were defined as systemic antibiotics prescribed at the time of the patient's injury, most often in the emergency department. All included patients in this study received a prescription for chlorhexidine rinse when they were evaluated at the time of injury. Perioperative antibiotics were given within 1 hour of surgical incision.[15] Postoperative complications, including infection (with culture/susceptibility results if available), hardware complications, and need for further operations, were also recorded. "Postoperative infection" included patients who developed local cellulitis, abscess, or osteomyelitis during postoperative follow-up. "Hardware complications" included loosening or exposure of internal mandibular fixation plates. Given these definitions, patients who had surgery the same day as their injury were excluded from this analysis (►**Fig. 1**). Additionally, patients for whom the use of preoperative antibiotics was unknown were excluded. A few patients received an unknown preoperative antibiotic, and these were included.

Analysis

Categorical variables, including postoperative complications (infection and hardware complications), were used to

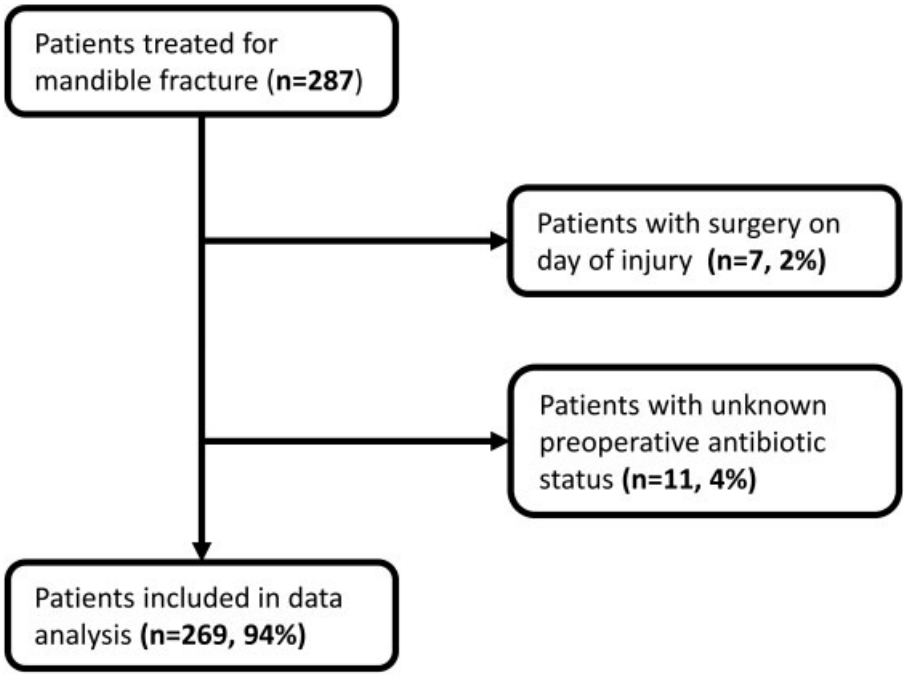

Fig. 1 Patient selection.

construct contingency tables and analyzed with Fisher's exact test or a chi-square test as appropriate using GraphPad QuickCalcs (GraphPad Software, San Diego, CA). Continuous variables were analyzed with the Student's unpaired *t*-test and reported ± 1 standard deviation. Multivariate logistic regression models were created with MedCalc (MedCalc Software, Ostend, Belgium). A two-tailed *p*-value <0.05 was considered statistically significant.

Results

Characteristics of Study Subjects

A total of 269 patients were eligible for inclusion in the study (►**Fig. 1**). Patient demographics, mandible fracture details, and smoking status are summarized in ►**Table 1**. A total of 80% of patients with mandible fractures received preoperative antibiotics. Patient's age at the time of injury was not significantly associated with the decision to prescribe (mean age: 27.9 ± 13.7 years) or not to prescribe (mean age: 24.5 ± 12.9 years) preoperative antibiotics ($p = 0.102$). Mechanisms of mandible fracture, in decreasing order of occurrence, included assault, vehicle accidents, falls, and gunshot wounds. The mechanism of injury was not significantly associated with the decision to prescribe preoperative antibiotics ($p = 0.623$). Similarly, fracture location was not associated with preoperative antibiotic use ($p = 0.729$). The number of discrete mandible fractures in each patient was also not associated with preoperative antibiotic prescribing ($p = 0.980$). Although approximately 45% of patients were current smokers, their smoking status did not have a significant association with the prescription of preoperative antibiotics ($p = 0.168$). Almost all (98%) patients received perioperative antibiotics at the time of operative repair (►**Table 2**). The most common antibiotics given perioperatively (in the operating room before incision) were cefazolin and clindamycin. There was no significant difference in the perioperative antibiotic agent chosen between the group of patients who received preoperative antibiotics and the group who did not ($p = 0.141$).

Patients who received preoperative antibiotics were treated for an average of 6.3 ± 3.0 days (►**Table 3**). There was no difference in the time from injury to operative repair

Table 1 Demographics, fracture characteristics, and smoking status of patients with mandible fractures ($n = 269$) in database

	Received preoperative antibiotics ($n = 216$, 80%)		Did not receive preoperative antibiotics ($n = 53$, 20%)	
	n	%	*n*	%
Age at the time of injury				
< 18	48	22%	19	36%
≥ 18	168	78%	34	64%
Mean age	27.9 ± 13.7[a]		24.5 ± 12.9[a]	
Mechanism of injury				
Assault	135[a]	63%	36[a]	68%
Vehicle accident	39[a]	18%	9[a]	17%
Fall	27[a]	13%	6[a]	11%
Gunshot wound	9[a]	4%	0[a]	0%
Other	6[a]	3%	2[a]	4%
Fracture location				
Symphysis or body	32[a]	15%	6[a]	11%
Angle or ramus	27[a]	13%	8[a]	15%
Condyle	4[a]	2%	2[a]	4%
Multiple	153[a]	71%	37[a]	70%
Number of fractures				
1	63[a]	29%	16[a]	30%
2	131[a]	61%	32[a]	60%
3 or more	22[a]	10%	5[a]	9%
Smoking status				
Smoker	101[a]	47%	19[a]	36%
Nonsmoker	115[a]	53%	34[a]	64%

Note: None of these variables were associated with the decision to prescribe preoperative antibiotics.
[a]$p > 0.05$.

Table 2 Preoperative antibiotic usage and perioperative antibiotic choice

Perioperative antibiotic	Preoperative antibiotics prescribed	Percentage of total	No preoperative antibiotics prescribed	Percentage of total
Ampicillin/Sulbactam	33	15%	8	15%
Cefazolin	48	22%	19	36%
Clindamycin	123	57%	24	45%
Other	8	4%	0	0%
None	4	2%	2	4%
Total	216		53	

Note: $p = 0.141$ (chi-square test).

Table 3 Duration of antibiotic use and the time from injury to surgery

	Received preoperative antibiotics	Did not receive preoperative antibiotics
Mean preoperative antibiotic duration (days)	6.3 ± 3.0	N/A
Mean time from injury to surgery (days)	8.7 ± 6.1[a]	10.2 ± 9.6[a]

[a] $p > 0.05$.

between the groups of patients who received preoperative antibiotics (8.7 ± 6.1 days) and those who did not (10.2 ± 9.6 days, $p = 0.167$; ►**Table 3**).

Postoperative Outcomes

Of the 216 patients who received preoperative antibiotics, 22 (10.2%) developed an infection postoperatively. Of the 53 who did not receive preoperative antibiotics, 2 (3.8%) developed infection ($p = 0.184$; ►**Table 4**). Fourteen of the 216 (6.5%) patients treated with preoperative antibiotics had hardware complications, compared with 2 of 53 (3.8%) patients who did not receive preoperative antibiotics ($p = 0.746$; ►**Table 5**). When controlling for age at the time of injury and smoking in a multivariate logistic regression, preoperative antibiotic use was still not significantly associated with either postoperative infection or hardware complication (►**Table 6**). The majority of patients in our series had mandible fractures in multiple locations; thus, an analysis of infections or hardware complications stratified by fracture location could not be performed. Preoperative antibiotic choices are listed in ►**Table 7**. The two most commonly used preoperative antibiotic agents, clindamycin and amoxicillin, had similar postoperative infection rates (12.8 and 11.8%, respectively, $p = 1.00$) and were similar to the overall infection rate with any preoperative antibiotics (10.2%).

Discussion

A significant majority (80%) of patients treated for mandible fractures at our institution over a 10-year period received preoperative antibiotics between time of injury and operative repair. Most patients were discharged home from the

Table 4 Use of preoperative antibiotics and postoperative infection rate

	Postoperative infection	No postoperative infection	Percent with infection
Preoperative antibiotics	22	194	10.2%
No preoperative antibiotics	2	51	3.8%

Note: $p = 0.184$.

Table 5 Use of preoperative antibiotics and hardware complication rate

	Hardware complication	No hardware complication	Percent with complication
Preoperative antibiotics	14	202	6.5%
No preoperative antibiotics	2	51	3.8%

Note: $p = 0.746$.

Table 6 Multivariate logistic regression models of postoperative infection and hardware complication

	Postoperative infection			Hardware complication		
	OR	95% CI	*p*	OR	95% CI	*p*
Age at the time of injury	1.01	0.98–1.04	0.49	1.00	0.96–1.04	0.94
Smoking status	1.55	0.62–3.89	0.35	2.14	0.69–6.67	0.19
Preoperative antibiotics	2.67	0.60–11.81	0.20	1.64	0.36–7.50	0.53

Abbreviations: CI, confidence interval; OR, odds ratio.
Note: In this model, none of the included variables were significantly associated with either postoperative infection or hardware complication.

Table 7 Preoperative antibiotic choice and postoperative infection rate

Antibiotic	Postoperative infection	No postoperative infection	Percentage with infection
Ampicillin/Sulbactam	1	7	12.5%
Amoxicillin	4[a]	30[a]	11.8%
Amoxicillin/Clavulanate	0	21	0.0%
Cefazolin	0	3	0.0%
Cefepime	0	1	0.0%
Cephalexin	1	6	14.3%
Ciprofloxacin	0	1	0.0%
Clindamycin	14[a]	95[a]	12.8%
Doxycycline	0	1	0.0%
Penicillin	1	7	12.5%
Sulfamethoxazole/Trimethoprim	0	2	0.0%
Multiple	1	17	5.6%
Unknown	0	3	0.0%
Total	**22**	**194**	**10.2%**
None	**2**	**51**	**3.8%**

[a] $p > 0.05$.

emergency department with mandible fractures as their only injury requiring further treatment. Our study does not show any significant difference in postoperative infection rates after mandible fracture repair regardless of preoperative antibiotic treatment. Similarly, there was no difference in rates of hardware complications. This was still the case when controlling for age and smoking in a multivariate logistic regression. Use of antibiotic therapy in the period between the injury and surgical treatment of a mandible fracture did not provide any benefit to this patient population. Generally, open fractures are considered a significant risk for infection and treated with antibiotics as soon as possible after the injury. However, the proximity of mandible fractures to oral flora makes them a special case. Most mandible fractures are open or considered to be open, and this distinction does not appear to affect the risk of infection. The current protocol at our institution is to withhold preoperative antibiotics and prescribe only chlorhexidine oral rinse.

There is, however, high-quality evidence for use of antibiotics immediately before surgical instrumentation of mandible fractures.[16] Two randomized controlled trials showed a statistically significant decrease in postoperative infections with perioperative antibiotics compared with control.[17,18] Evidence does not support continuation of antibiotic therapy through the postoperative period for reduction of infection.[18,19] Given these and other data, Mundinger et al assigned a Grade A recommendation (based on the American Society of Plastic Surgeons Scale for Grading Recommendation guidelines) in favor of perioperative antibiotic and against postoperative antibiotic use in all types of mandible fractures.[6] Regarding choice of antibiotic agent, ampicillin/sulbactam used perioperatively has a significantly lower rate of infection than either clindamycin or cefazolin.[20] Patients in this study received a variety of antibiotics perioperatively, including ampicillin/sulbactam in a minority of cases, but the perioperative agents used in patients treated with and without preoperative antibiotics were not significantly different. It is unlikely that perioperative antibiotic choice affected the postoperative infection rates seen in this study.

Some confusion among treating physicians may have resulted from the terminology describing antibiotic use at the time of surgery in the literature. The term "preoperative antibiotics" is often used to refer to drugs given at the time of

surgery, even though these may be more accurately called "perioperative antibiotics." Additionally, a recent review by Andreasen and colleagues uses the term "prophylactic antibiotics" to refer to both pre- and perioperative treatment.[16] Although both situations involve preventing the spread of bacteria, the presurgical and surgical environments are vastly different.

Postoperative infection occurred at a higher rate in patients who received preoperative antibiotics (10 vs. 4%), although this difference was not statistically significant. It is possible that use of preoperative antibiotics increases the proportion of resistant organisms in the oral flora in patients with mandible fractures. While the overall complication rate tends to be lower for open reduction/internal fixation (ORIF) versus closed reduction for mandible fractures,[21,22] open techniques involve disruption of mucosal barriers to infection that could promote the spread of these antibiotic-resistant bacteria. In addition, smoking,[20] chronic alcohol abuse,[23] intravenous drug use,[23] and diabetes[24] are associated with higher complication rates in mandible fractures. It is possible that these risk factors may make preoperative antibiotics useful for a subset of patients with mandible fractures.

The limitations of our study are inherent to its retrospective, observational design. The accuracy of the reported data is dependent upon the accuracy of the medical record, and some instances of antibiotic administration or postoperative infection may have been omitted. This is especially true since some patients were treated before the widespread use of electronic medical records and data collection relied on scanned charts. The fact that all patients in our study presented to or were transferred to a single Level I trauma center could cause a selection bias for included patients. It is likely that patient factors not captured in the medical record had an influence on the decision to prescribe preoperative antibiotics. Additionally, the majority of patients in our study had mandible fractures in multiple locations, precluding an analysis of preoperative antibiotic use and complication risk stratified by location. However, the decision to prescribe preoperative antibiotics was made by the attending physician on duty as specified by a rotating call schedule. An adequately powered prospective randomized controlled trial would produce stronger evidence for or against a cause-and-effect relationship between preoperative antibiotics and postoperative infection.

Despite the aforementioned limitations, our study has drawn conclusions from a large longitudinal sample of patients treated for mandible fractures by multiple physicians. Our results provide evidence that preoperative antibiotics should not be routinely prescribed when patients with mandible fractures are treated in the emergency department and provide a basis for subsequent prospective analysis.

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